

ANNOTATIONES ZOOLOGICAE JAPONENSES

Volume 48, No. 3—September 1975

Published by the Zoological Society of Japan

The Geographical Differentiation of the Cave Milliped,
*Prionomatis nanaoredense**

With 4 Text-figures

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ABSTRACT Three new subspecies of the cave milliped, *Prionomatis nanaoredense*, are described from central Kyushu, Japan. They are *P. n. elongatum* n. subsp., *P. n. incisum* n. subsp. and *P. n. expansum* n. subsp. The first two are found in limestone caves in Kumamoto Prefecture, and the last in a tuff cave in Miyazaki Prefecture. All these new millipeds resemble the nominate form of *P. nanaoredense* in general appearance, but can be distinguished from one another by the shape of gonopodal telopodites.

Prionomatis nanaoredense Miyosi (1956, pp. 13, 14, fig. 1) is a white eyeless milliped occurring in the caves of central Kyushu, Southwest Japan. It was originally described from Nanaoré-dô Cave, and later recorded also from Tsugenotaki-dô Cave (Miyosi, 1959, p. 112; erroneously cited as "Tsugé-no-dô") and Taishi-ga-iwaya Cave (Irie and Arai, 1975). These three caves belong to the same drainage system and are geographically close to one another, although Tsugenotaki-dô and Taishi-ga-iwaya are situated at the opposite side of the Gokasé-gawa River to the type cave. It is, therefore, not surprising that the specimens from these caves are perfectly identical with one another.

According to recent investigations, it became apparent that the species occur in four other caves in the Gokasé-gawa and Midori-gawa drainages. The specimens from these new localities agree with topotypical ones in the form of body as well as in the general structure of gonopods, but differ from the latter and from one another in the shape of gonopodal telopodites. Though not large, the difference seems constant, showing that the species becomes differentiated into geographical races. In the present paper, the authors are going to divide *P. nanoredense* into four sub-

* Contribution No. 155 from the Spelaeological Society of Japan.

species, three of which are new to science.

All the type-specimens of the new millipeds described in this paper will be deposited in the collection of the National Science Museum, Tokyo.

Prionomatis nanaoredense Miyosi

[Japanese name: Ishikawa Nokogiriyasude]

(Fig. 1)

Prionomatis nanaoredense Miyosi, 1956, *Zool. Mag., Tokyo*, **65**, pp. 13, 14, fig. 1; 1959, *Über japanische Diplopoden*, Osaka, pp. 111, 112, fig. 158.

Specimens examined. 13 larvae, limestone cave called Nanaoré-dô, at Tokuzumi, Hinokagé-chô, Miyazaki Prefecture, 8 August 1967, coll. by Y. Murakami; 7 ♂♂, 5 ♀♀, 27 larvae, the same cave, 28 March 1969, coll. by Y. Murakami. 2 ♀♀, limestone cave called Tsugenotaki-dô at Kuronita, Takachiho-chô, Miyazaki Prefecture, 20 November 1957, coll. by S. Uéno; 1 ♂, 2 ♀♀, the same cave, 11 August 1973, coll. by T. Irie. 4 ♂♂, limestone cave called Taishi-ga-iwaya, at Mizuguchi, Takachiho-chô, Miyazaki Prefecture, 11 August 1973, coll. by T. Irie.

Color in alcohol greyish white; in life white. Length of both sexes 22–25 mm, greatest width about 2.6 mm. Body slender, parallel-sided between segments 6 and 16, gradually narrowing toward both ends. The shape of head and of selected segments in a male specimen as shown in Fig. 1 A–C; the width of them as follows:

Head = 1.8 mm	Collum = 1.6 mm	Seg. 2 = 1.8 mm
Seg. 3 = 1.8 mm	Seg. 4 = 2.0 mm	Seg. 5 = 2.3 mm
Seg. 6 = 2.6 mm	Seg. 17 = 2.3 mm	Seg. 18 = 2.0 mm.

Head subglobular, convex and covered with short hairs except at the back of vertex. Antennae long and slender, reaching back to the anterior border of segment 4; the ratio in length of articles 2–7 and in width of articles 5–7 (in parentheses) is 20:30:22:23(7):20(9):9(6); sensory hairs and prominence of the last three articles well developed. Collum slightly narrower than head, subelliptic; each side with a weak notch, posterior corner minutely produced; a series of 20 erect bristles present along the anterior margin, four series of short bristles on the surface.

Segments 2, 3 and 4 narrower than most of the succeeding segments; dorsum moderately arched, with three rows of microscopic tubercles; outer margin of lateral keels regularly with three conspicuous notches; posterior corners moderately produced. Succeeding segments basically similar in structure to one another; dorsum moderately arched, and with transverse median streak and very weak sculpture on each segment; the anterior half of metazonite with two rows of microscopic tubercles, the posterior half with two or three rows of similar tubercles. Lateral keels moderately developed, nearly horizontal, and slightly convex on the upper side. Outer margin convex, with usually five, rarely four or six notches; scapular area rather thickly bordered by marginal depression and provided with microscopic strigils on the surface, though they are nearly absent on segment 5; posterior corners moderately produced, with several rows of microscopic tubercles on the inner mar-

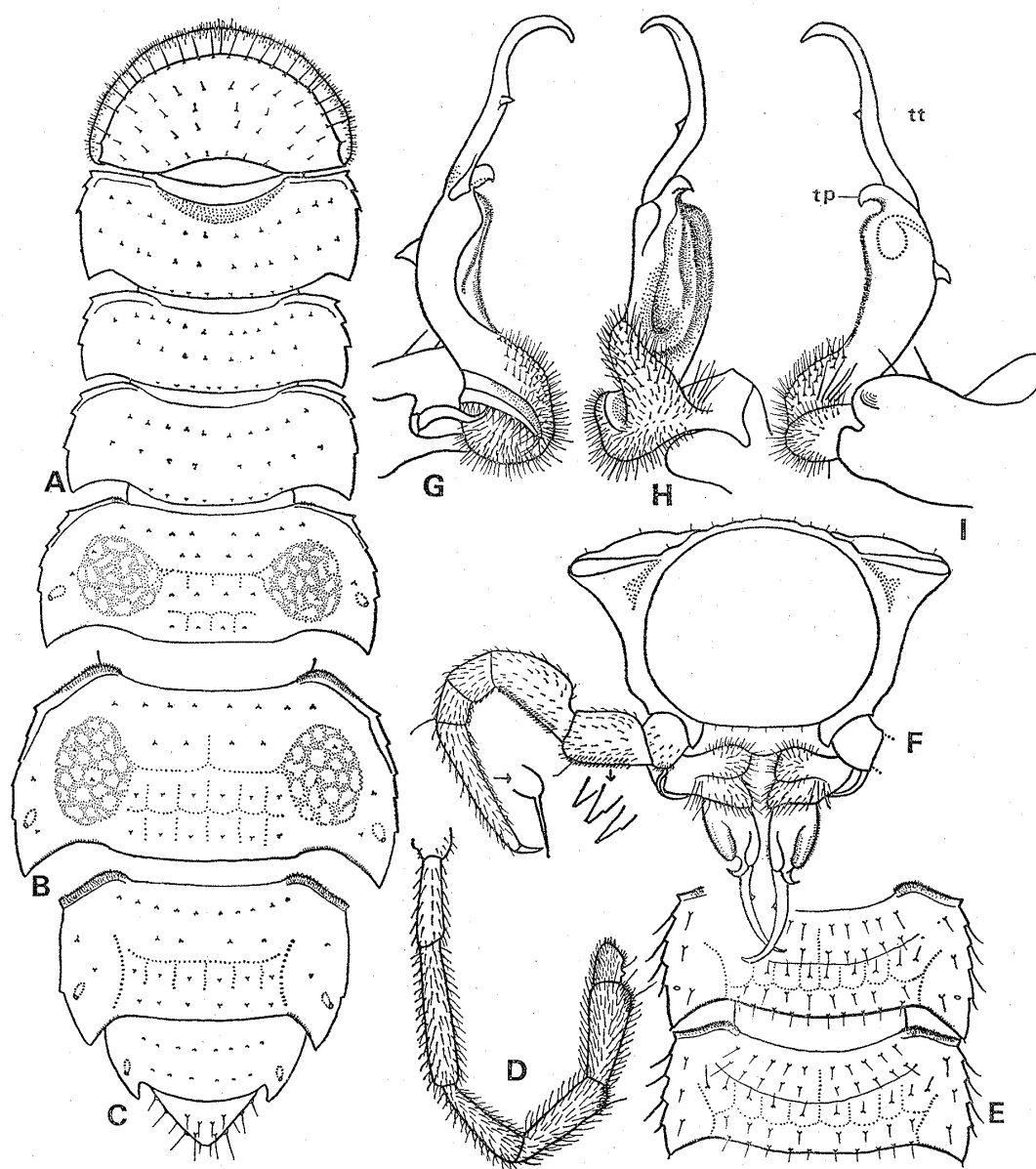


Fig. 1. *Prionomatis nanaoredense nanaoredense* Miyosi, of Nanaoré-dô Cave.—A, Head and five succeeding segments, dorsal aspect. B, Segment 10, dorsal aspect. C, Caudal end of body, dorsal aspect. D, Right antenna. E, Segments 10 and 11 in a larval specimen with 15 body segments, dorsal aspect. F, Segment 7, caudal aspect. G–I, Left gonopod, mesial, ventral and lateral aspects. tt=tibiotarsus, tp=terminal process.

gins. Pores very small, open on the dorsal surface near the last notch on each pore-bearing keel. Sternite quadrate, pubescent and deeply impressed transversely, with its posterior corners slightly produced; sternal impression shallow in female. Legs moderately long and slender; prefemur and femur slightly swollen dorsally, densely covered with thick bristles on the ventral surface; postfemur, tibia and

tarsus normal in shape, with spherical bristles on the under surface; claw rather short; legs in female slender than those of male, having no such secondary modifications.

Gonopodal aperture large, transversely oval, its posterior margin being moderately concave. Gonopods relatively large, of the form as illustrated in Fig. 1 F-I. Telopodites, *in situ*, lying parallel to the median body axis, with terminal portions crossed each other. Femur large, moderately broad; clivus low and thick, densely covered with microscopic tubercles; terminal process (*tp*) rather small and hook-shaped, with marginal tubercles on the inner side; outer horn present, small and triangular. Tibiotarsus very long and slender, slightly curving sigmoid, and with a small triangular tooth at the middle.

Notes. In the type-locality (Nanaoré-dô Cave), the milliped was found on the damp floor or around organic matters lying in a very wet part of a dark room not far from the entrance.

Prionomatis nanaoredense elongatum n. subsp.

[Japanese name: Soyô Nokogiriyasude]

(Fig. 2)

Diagnosis. Discriminated from the nominate subspecies chiefly by the difference in the shape of male gonopods: elongated terminal process of femur.

Male holotype. Color white. Length about 25 mm, greatest width 2.2 mm. The form of body essentially similar to that of the nominate subspecies. The width values of some selected segments as follows:

Head =1.6 mm	Collum=1.6 mm	Seg. 2=1.7 mm
Seg. 4=1.8 mm	Seg. 5=2.0 mm	Seg. 6=2.2 mm
Seg. 15=2.2 mm	Seg. 17=2.0 mm	Seg. 19=1.3 mm.

Antennae slender, approximately 4.0 mm long, reaching back to the anterior border of segment 4; the ratio in length and width (in parentheses) of articles 4 through 7 is as follows: 23(6) : 22(7) : 19(8) : 8(6); sensory hairs on articles 5 and 6 well developed, though very fine. Collum subelliptic, as wide as head, and with five rows of bristles along the anterior margin and on the surface. The arrangement of lateral notches and other somatic characters similar to those in the nominate subspecies.

Gonopods very similar to those in the nominate subspecies, as shown in Fig. 2. Femoral portion wide and with conspicuously elongated terminal process (*tp*); terminal process projecting ventrad, falciform, and with marginal serration at the inner side. Outer horn smaller than that of the nominate form.

Female unknown at present.

Type-series. 1 ♂, 2 larvae, limestone cave called Nanatsuzako-no-ana, at Nanatsuzako of Mamihara, in Soyô-chô, Kumamoto Prefecture, 27 August 1969, coll. by T. Irie.

Notes. Nanatsuzako-no-ana Cave is located about 16 km west of Tsugeno-

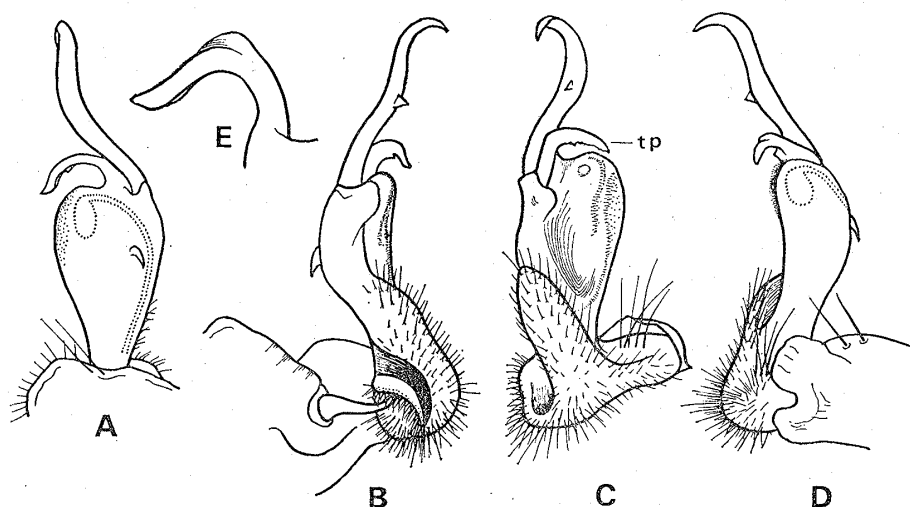


Fig. 2. *Prionomatis nanaoredense elongatum* n. subsp., holotype, of Nanatsuzako-no-ana Cave. —A-D, Left gonopod, dorsal, mesial, ventral and lateral aspects. E, Terminal process. tp=terminal process.

taki-dô Cave and about 21 km west-northwest of Nanaoré-dô Cave. The milliped was found on the damp floor and walls of the inner room, which is about 15 m below the entrance.

Prionomatis nanaoredense incisum n. subsp.

[Japanese name: Tsubaki Nokogiriyasude]

(Fig. 3)

Diagnosis. Distinguished from the nominate and the preceding subspecies chiefly by the differences in the shape of gonopods: terminal incision of tibiotarsus and subfurcation of terminal process.

Male holotype. Color white. Length approximately 24 mm, greatest width 2.6 mm. Body slender, and the width values of some selected segments as follows:

Head =1.8 mm	Collum=1.6 mm	Seg. 2=1.9 mm
Seg. 3=1.9 mm	Seg. 4=1.9 mm	Seg. 5=2.3 mm
Seg. 7=2.6 mm	Seg. 17=2.3 mm	Seg. 19=1.4 mm.

Sensory hairs on antennal articles 5 and 6 well developed, and sensory prominence on article 7 well protuberant, though being a little smaller than that in the nominate subspecies. Collum without notch on each side. Posterior corners of lateral keels well produced from segment 2. Other somatic characters are the same as those in the nominate form.

Gonopods essentially similar to those in the nominate form. Terminal process (tp) on femur rather large and unequally subfurcated. Tibiotarsus slender, without accessory tooth; the tip uncinated with small incision. Outer horn present and small.

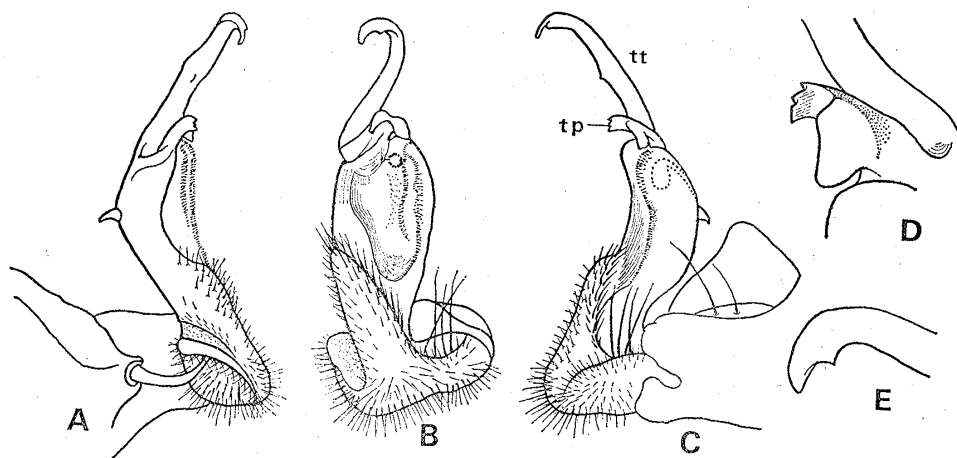


Fig. 3. *Prionomatis nanaoredense incisum* n. subsp., holotype, of Daini-tsubaki-dô Cave. — A–C, Left gonopod, mesial, ventral and lateral aspects. D, Terminal process. E, Distal portion of tibiotarsus, showing small incision. tp=terminal process, tt=tibiotarsus.

Female paratype. About 25 mm in length. Other somatic characters as in the male.

Type-series. 2 ♂♂ (including the holotype), 4 ♀♀, 10 larvae, limestone cave called Daini-tsubaki-dô, at Tsubaki, Chû-ô-son, Kumamoto Prefecture, 15 April 1969, coll. by S. Uéno; 1 ♀, the same cave, 15 June 1967, by T. Irie; 5 ♂♂, 1 ♀, the same cave, 27 September 1967, by T. Irie; 1 ♂, the same cave, 18 February 1968, by T. Irie; 1 ♂, the same cave, 15 April 1968, by T. Irie; 1 ♂, the same cave, 15 June 1969, by T. Irie; 1 ♂, the same cave, 22 February 1970, by T. Irie; 1 ♂, the same cave, 25 March 1970, by T. Irie. 1 ♂, limestone cave called Daiichi-tsubaki-dô, at Tsubaki, Chû-ô-son, Kumamoto Prefecture, 5 August 1968, coll. by T. Irie.

Notes. The two caves, Daiichi-tsubaki-dô and Daini-tsubaki-dô, lie in the Midori-gawa drainage about 6 km south of the town of Kôsa, and are open on either side of a narrow ravine (cf. Uéno, 1970). They are about 31 km distant to the southwest from Nanatsuzako-no-ana Cave (the type-locality of *P. n. elongatum*). Daiichi-tsubaki-dô Cave is known also to harbour *P. iriei* (Murakami, 1974, pp. 187–190), and is unique in the sympatric occurrence of two different species of *Prionomatis*. The milliped in the Daini-tsubaki-dô Cave was usually found on the damp floor and walls in the innermost room. The junior author is now studying the life history of this milliped.

Prionomatis nanaoredense expansum n. subsp.

[Japanese name: Togawa Nokogiriyasude]
(Fig. 4)

Diagnosis. Distinguished from the nominate form and subsp. *elongatum* and *incisum* chiefly by the larger terminal process on femur and tibiotarsal tooth, and by the absence of outer horn.

Male holotype. Color in alcohol pale greyish white; in life white. Length about 24 mm, greatest width 2.4 mm. The width values of some selected segments as follows:

Head =1.9 mm	Collum=1.7 mm	Seg. 2=1.9 mm
Seg. 3=1.9 mm	Seg. 4=2.0 mm	Seg. 5=2.2 mm
Seg. 6=2.4 mm	Seg. 16=2.3 mm	Seg. 19=1.4 mm.

Head and succeeding segments essentially similar to those of the nominate form. Antennae very similar in shape to those of subsp. *incisum*. Lateral side of typical keels slightly convex, with rather sharp serration.

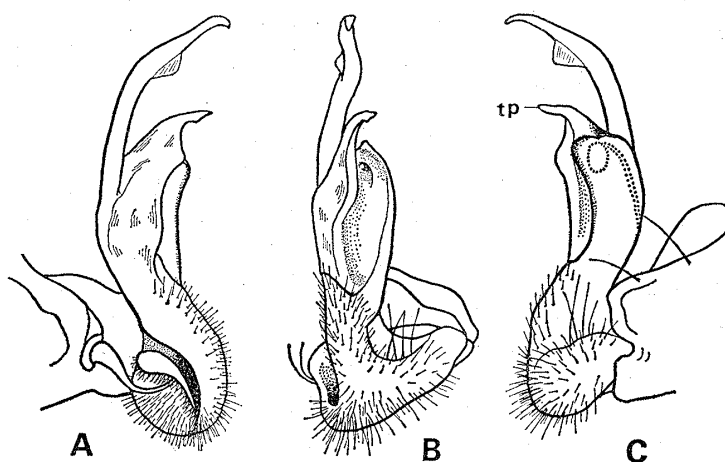


Fig. 4. *Prionomatis nanaoredense expansum* n. subsp., holotype, of Togawa-dô Cave.—
A-C, Left gonopod, mesial, ventral and lateral aspects. tp=terminal process.

Gonopods essentially similar to those of the nominate subspecies. Terminal process (*tp*) characterized as shown in Fig. 4; terminal corner at the inner side of femur expanded, moderately lamellar, and acutely contracted at the distal part. Tibiotarsal shaft slender, with a tooth which is rather large and very thin. Outer horn absent.

Female paratype. Length about 21 mm. Other somatic characters as in the male.

Type-series. 1 ♂ (holotype), 1 ♀, tuff cave called Togawa-dô, at Togawa, Hinokagé-chô, Miyazaki Prefecture, 2 March 1974, coll. by T. Irie; 1 larva, the same cave, 24 November 1972, coll. by T. Irie.

Notes. Togawa-dô Cave lies about 5 km north of the town of Hinokagé on the right side of the Hinokagé-gawa that is a branch of the Gokasé-gawa River. Its location is about 3.5 km east of Nanaoré-dô Cave. The milliped was found on the damp floor and walls in the dark place about 15 m distant from the entrance.

ACKNOWLEDGEMENT

The authors wish to express their hearty thanks to Dr. Shun-Ichi Uéno of the National Science Museum, Tokyo, for constant guidance and encouragement in the course of this study as well as for kindly reading the original manuscript.

REFERENCES

- Irie, T., 1969. The limestone caves and their faunas of the Hitoyoshi-Kuma-Itsuki-Gokanoshô Area. *Kumamoto-ken Hitoyoshi-Kuma-Gokanoshô Chiku Shizen-kôen-kôhochi Gakujutsu-chôsa Hôkoku-sho, Kumamoto*, pp. 137-158. (In Japanese.)
- and S. Arai, 1975. The cave faunas of the Takachiho Area, Kyushu. *Mogura* (Kumamoto Speleological Club), (5): 21-26. (In Japanese.)
- Ishikawa, J., 1958. The limestone caves and their faunae in the Kyushu District. *Mem. Kôchi Women's Univ.*, 6 (Nat. Sci.): 7-22. (In Japanese, with English résumé.)
- Miyosi, Y., 1956. Beiträge zur Kenntnis japanischer Myriopoden. 16. Aufsatz: Über 3 neue Arten von *Prionomatis*. *Zool. Mag., Tokyo*, 65: 13-16. (In Japanese, with German résumé.)
- 1959. Über japanische Diplopoden. iii+223 pp. Arachnological Society of East Asia, Osaka. (In Japanese.)
- Murakami, Y., 1974. Two new cave millipeds of the genus *Prionomatis* from Kumamoto Prefecture in Southwest Japan. *Annot. zool. Japon.*, 47: 187-193.
- Uéno, S.-I., 1959. New cave trechids from the Gokasé-gawa drainage area of Kyushu. *Mem. Coll. Sci. Univ. Kyoto*, (B), 26: 37-44.
- 1970. The cave trechines (Coleoptera, Trechinae) of Kumamoto Prefecture in Southwest Japan. *Bull. Natn. Sci. Mus., Tokyo*, 13: 91-116.